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Combi-Decoder SL75 for N/TT & small HO/OO

Translation to English and annotation by YouChoos (<u>www.youchoos.co.uk</u>) – 3rd edition, October 2011



Technical data and installation

Track voltage DCC	8-21V
Maximum continuous current to motor	0.6A
Maximum peak current to motor 5sec	1.2A
Maximum continuous current aux. functions	250mA each
Maximum total current all aux. functions	0.8A
High frequency motor control	32kHz or 16kHz
Low frequency motor control	30-150Hz
Dimming frequency	1.2kHz
Maximum continuous output sounds	11kHz or 22kHz 1W/8Ohm 16-bit
Maximum sound memory capacity at 11kHz, 16 bit (mono) 16Mbit (2Mb)	170 seconds
Operating temperature	-10 to 90'C
Dimensions	L*W*D 24/9/3.3mm

Connection of the SL75

View from above



BLUE – functions common positive BROWN *2 – speaker GREEN – F1 VIOLET – F2

View from below

DCI	

ORANGE – motor right
GREY – motor left
BLACK – track left
RED – track right
WHITE – F0 front light
YELLOW – F0 rear light

Notes on Installation and Programming

Hard Reset: CV1=0 resets all CVs to factory setting, depending upon the setting of CV109.

Speaker Impedance: The connected loudspeaker must have an impedance of 80hm, such as the speaker supplied with the decoder. Speakers with lower impedance must have a resister connected in series with the loudspeaker giving a combined resistance of 80hm.

Reed Switch: For use of a Reed Contact for synchronised steam stroke, the Reed Contact 1 should be connected to the positive function output (BLUE).

Some DCC systems only support limited CV addressing from 0-99, such as Roco Lokmaus. Therefore programming of CV-values above 99 is not directly possible. The SL51-4 offers a solution to this problem by setting CV53=1 the following CV that is being programmed will get 100 added, and similarly, setting CV53=2 means that the following entry will get value starting at 200. For setting of values from 0-99, CV53 must be set to 0.

The quiescent current (under no load) of the decoder is approximately 10mA, this is caused by the audio amplifier. Therefore it is normal for the decoder to produce some heat even under no operation. During operation, it is usual to expect a temperature of around 70'C.

The SL75 behaves as a NRMA-compliant decoder during running on the main. For programming including acknowledgement and read-back of CV values, it may be necessary to disconnect the speaker.

The SL75 is best suited for use in N scale locos. However, it will also function ok in smaller OO/HO models. Signs that the decoder is working beyond its limits generally manifest themselves by functions/sounds not responding to requests. For example, a whistle sound may be requested, but this is not actioned. In general this will only occur when the loco is running fast and therefore does not have the power to receive and action requests cleanly. It should not cause damage to the decoder, although this cannot be guaranteed.

Understanding and Calculating Binary Values

In order to successfully understand and program some CVs, you will need a basic understanding of binary. Each CV contains what is called a *byte* of information. This is computer-speak for 8 *bits* of information, each of which can be ON or OFF. A *bit* is therefore a *toggle*, ON or OFF. A *1* represents ON and a *0* represents OFF. If you have just 1 bit, then you can have a maximum of 2 values i.e. on and off. Adding more bits means you can have more combinations, for example, 2 bits gives you 4 possible combinations: OFF+OFF; OFF+ON; ON+OFF; ON+ON, or 0,0; 0,1; 1;0; 1;1. Read this as 0,1,2,3 since computers always start at 0 instead of 1.

By convention, bits are read with the least significant to the right i.e. "bit 0" is the right-most bit. A byte, as mentioned previously has 8 bits, so bits 0 to 7, giving a possible range of 0-255 (2^8-1 being the maximum value, 256 combinations). Use the table below for reference to see what value each bit can represent.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
128	64	32	16	8	4	2	1

An example: if bit 6 is ON and bit 1 is also ON, then this is 64+2, so the value represented is 66. Simple really!

Many of the CVs in your decoder use individual bits to control different aspects, so it is useful to understand binary in order to a) work out how the decoder is currently configured, and b) to understand how to modify the CVs to change the decoder's behaviour.

Configuration Table (CVs)

The table below is a translation of the original CT Elektronik document, plus some notes on usage and experiences by YouChoos. It is not intended to be exhaustive, particularly in those areas not utilised by YouChoos, such as coupling, LGB engines, or Zimo systems features.

с٧	Explanation	Default	Range
1	Locomotive address: For short addresses when CV29 Bit 5 is set at 0.	3	1-127
2	Starting voltage: Voltage to motor at speed step 1. Tune this if your motor requires a little more umph to get it going,	3	0-255
	or you may find that the start-off sounds are not totally synchronised with the actual physical moving off of the loco.		
3	Rate of acceleration – adjust to affect the inertia effect of speeding up. Set to 0 if you want no inertia effect – you	4	0-255
	control the speed immediately with your controller instead.		
4	Rate of deceleration – similar to the above CV3, but for slowing down	4	0-255
5	Maximum speed: 0 for no artificial limit (maximum 255 has same effect as 0)	0	0-255
6	Middle speed: together with CV2 and CV5 a three-point speed curve can be set. Set CV6 = 0 to give a linear speed	0	0-255
	curve.		

7	Version Number – read-only	-	variable
8	Manufacturer ID: CI Elektronik–117 – read-only	117	0-255
0	Material Content for a second se	11/	0-233
9	Motor PWM: 13-03 Stepless from 30-150HZ,	134	00-03
	141-191 16kHz for coreless and bell anchor motors		134-191
13	Analog mode: Use bits 0-3 to determine which function outputs (1-4) are switched on when operating on DC.	0	0-255
17+18	Extended address: CV29 bit 5 must be set in order to use a long address. CVs 17+18 are used to specify the long	0	128-10240
	address. Please refer to NMRA standards for how this value is calculated.		
19	Multi-Unit (Consist) address	0	1-127
29	Miscellaneous configuration hits:	2	0-255
	Bit 0 (1) - Direction: OFF-normal: ON-inverted	-	0 200
	Bit 1 (2) Speed store: $OE=14/27 \cdot OI=20/29$		
	Di 1 (2) – Speed steps, $O(T - 14/27)$, $O(N - 20/120)$		
	Bit 2 (4) – Operating mode. OFF-digital only, ON-EC and Digital		
	Bit 4 (16) – Speed curve: OFF = default speed curve using CVs 2, 5 & 6; ON = free speed curve using CVs 67-94.		
	Bit 5 (32) – Address selection: OFF=1-127 (uses CV1); ON=128-10240 (uses CV1/+18)		
	Bit 6 (64) – not used		
	Bit 7 (128) – not used		
30	Error diagnosis: 1=motor; 2=light; 3=both short-circuit	0	0-3
33-42	Function mapping: according to NMRA for F0-F7, CV33-42=0. Please refer to CT extended function mapping		0-255
	document for more information.		
43-46	Function mapping: according to NMRA for F8-F11 CV43-46=0. Please refer to CT extended function mapping		0-255
	document for more information		
49	Configuration bits for sound:	0	0-255
	CV49=0 gives 4 cylinder steam engine	Ĭ	0 200
	Bit 0 (1) - set if you use a Dead switch for wheel curchronising for steam appings - see also 0/122-number of Bood		
	Contacts – pulses per stroke e.g. (V133–1 moons 1 stroke/pulse)		
	Contacts parases per stroke e.g. CVIDS-1 intentis I stroke/parase		
	DILL (2) – Set for Diesel or Electric loco (for USE WITH THE AUTO Sound Slots) Set both Rise 0. 8: 1 (value 2) for discal and also this sound at this to be found of the ODE 11 ($(1, 1, 2)$).		
	Set both bits U & 1 (value 3) for dieser and electric sounds that use Sound Slots UU to 11 (must all be filled with sounds)		
	- This is deprecated by the use of the AUTO sound slots (also known as Slots 1000-3000), so is not recommended.		
	Bit 2 (4) gives 2 cylinder steam		
	Bit 3 (8) gives 3 cylinder steam		
	Bit 4 (16) – no steam strokes during downhill/deceleration (only idle sound)		
	Bit 5 (32) – evaluate the LGB pulse from F1		
	Bit 6 (64) – play no sound between stand-still and running e.g. whistle (Slots 21-23 and Slots 24-26)		
	Bit 7 (128) – no sound between running and stand-still e.g. brakes (Slots 27-29 and Slots 30-32)		
50	EMF intensity: how strong is EMF effect: 0=no influence; 255=maximum. If you plan to use locomotives in a consist	255	0-255
	then use a lower value. This reduces the effect of locos working against each other if they cannot be configured to		
	perform equally. Combine this value with CV51 and CV52 to cater for different motor types – often very smooth		
	running can be achieved by experimenting with these values, even on motors that are apparently jerky to begin with		
	under DCC		
51	B-Value: ontimises EME characteristics. Modify this to adapt to specific motor requirements (proportional part)	80	0-255
51	P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part).	80	0-255
51 52	P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part).	80 40	0-255
51 52 53	P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs	80 40 0	0-255 0-255 0-255
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51 52 53 54	P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programming and feedback on CV53=1: 100+ programmed CV value CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV	80 40 0 50	0-255 0-255 0-255 0-255
51 52 53 54	P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programming and feedback on CV53=1: 100+ programmed CV value CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not	80 40 0 50	0-255 0-255 0-255 0-255
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51 52 53 54 55	P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programmed and feedback on CV53=1: 100+ programmed CV value CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to	80 40 0 50 32	0-255 0-255 0-255 0-200 0-100
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51 52 53 54 55 55	P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programmed CV value CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler nulse time, how long is the impulse on the decoupler with full power with it is reduced to the level specified by this CV55 to hold it. Specified as a percentage.	80 40 0 50 32	0-255 0-255 0-255 0-255 0-100
51 52 53 54 55 55 56	 P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programming and feedback on CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV55. Time is set in 0.1 second units. 	80 40 0 50 32 60	0-255 0-255 0-255 0-255 0-255 0-100 0-100
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51 52 53 54 55 56 57 50	P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programming and feedback on CV53=1: 100+ programmed CV value CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV55. Time is set in 0.1 second units. Dimming mask: turns dimming (level defined in CV54) on and off for each function output. Each bit represents one function output, up to 4 functions (bits 0, 1, 2 and 3).	80 40 0 50 32 60 0	0-255 0-255 0-255 0-255 0-255 0-100 0-100 0-255 0-255
51 52 53 54 55 56 57 58	 B-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programming and feedback on CV53=21: 100+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV55. Time is set in 0.1 second units. Dimming mask for decoupler function: defined which outputs should have decoupler processing applied. Each bit 	80 40 0 50 32 60 0 0 0	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-255 0-255 0-255
51 52 53 53 54 55 56 57 58	 Bive Occ. P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programming and feedback on CV53=21: 100+ programmed CV value CV53=22: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV54) on and off for each function output. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. 	80 40 0 50 32 60 0	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-255 0-255 0-255
51 52 53 53 54 55 56 57 58 59	 Br.Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programmed CV value CV53=2: 200+ programmed CV value CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV54) on and off for each function output. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Signal controlled speed: "L" only available in ZIMO environment 	80 40 0 50 50 32 60 0 168	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-255 0-255 0-255 0-255
51 52 53 53 54 55 56 57 58 59 60	 Biver beer Biver beer P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=21: 100+ programmed CV value CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV55. Time is set in 0.1 second units. Dimming mask: turns dimming (level defined in CV54) on and off for each function output. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Signal controlled speed: "L" only available in Z	80 40 0 50 50 32 60 0 168 84	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-255 0-255 0-255 0-255 0-255 0-255
51 52 53 53 54 55 56 57 58 59 60 61	 B-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programmed CV value CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV55. Time is set in 0.1 second units. Dimming mask: turns dimming (level defined in CV54) on and off for each function output. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Signal controlled speed: "L" only available in ZIMO environment Signal controlled sp	80 40 0 50 50 32 60 0 168 84 1	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255
51 52 53 53 54 55 56 57 58 59 60 61 62	 B-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programming and feedback on CV53=11:100+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV55. Time is set in 0.1 second units. Dimming mask: turns dimming (level defined in CV54) on and off for each function output. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Signal controlled speed: "L" only available in ZIMO environment Signal contr	80 40 0 50 50 32 60 0 168 84 1 10	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255
51 52 53 53 54 55 56 57 58 59 60 61 62	 Diverse optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programming and feedback on CV53=21: 100+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV S7. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV54) on and off for each function output. Each bit represents one function output specified in CV54) on and off for each function output. Each bit represents one function output t. Any output specified here will have the effects of CV55 and 56 applied. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Each bit represents one function output. Any output specified here will have the effects o	80 40 0 50 52 60 0 168 84 1 10	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-255 0-255 0-255 0-255 0-255 0-255 0-255
51 52 53 54 55 56 57 58 59 60 61 62	 Diverse optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programming and feedback on CV53=72: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV S7. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV55. Time is set in 0.1 second units. Dimming mask: turns dimming (level defined in CV54) on and off for each function output. Each bit represents one function output. App outputs pecified here will have the effects of CV55 and 56 applied. Each bit represents one function: defined which outputs should have decoupler processing applied. Each bit represents one function output. Any output specified here will have the effects of CV55 and	80 40 0 50 52 60 0 1 10	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-255 0-255 0-255 0-255 0-255 0-255
51 52 53 54 55 56 57 58 59 60 61 62 64	 Diversion of the second seco	80 40 0 50 52 60 0 168 84 1 10 100	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-
51 52 53 53 54 55 56 57 58 59 60 61 62 64 67-94	 Diversion of the second state of the	80 40 0 50 52 60 0 168 84 1 10 100	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255
51 52 53 53 54 55 56 57 58 59 60 61 62 64 67-94	 Brock optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=2: 200+ programmed CV value PVMM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PVMM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV54) on and off for each function output. Each bit represents one function output, appendix defined which outputs should have decoupler processing applied. Each bit represents one function output, the of yavailable in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZI	80 40 0 50 52 60 0 168 84 1 10 100	0-255 0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255
51 52 53 53 54 55 56 57 58 59 60 61 62 64 67-94	 Diversion of the second seco	80 40 0 50 52 60 0 168 84 1 100	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255 0-255
51 52 53 53 54 55 56 57 58 59 60 61 62 64 67-94 96	 Diversion of the second seco	80 40 0 50 52 60 0 168 84 1 100 100	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-
51 52 53 53 54 55 56 57 58 59 60 61 62 64 67-94 96 97	 District Occi. P-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programmed CV value CV53=2: 200+ programmed CV value CV53=2: 200+ programmed CV value CV53=2: 200+ programmed CV value PWM for function output: specifies the level of dimming applied to any function output with dimming selected via CV 57. Note that any function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56). Time is set in 0.1 second units. Dimming mask: for decoupler function: defined which outputs should have decoupler processing applied. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed:	80 40 0 50 50 32 60 0 168 84 1 100 212	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-255 0-
51 52 53 53 54 55 56 57 58 59 60 61 62 64 67-94 96 97	 Diversion of the second seco	80 40 0 50 50 32 60 0 168 84 1 100 212 126	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-
51 52 53 54 55 56 57 58 59 60 61 62 64 67-94 96 97 98	 Privalue: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV33=67: programming and feedback off CV33=77: programmed CV value CV33=2: 200+ programmed CV value PWM for function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function outputs ded, designed to 'ikc' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV55) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Dimming mask: truns dimming (level defined in CV54) on and off for each function output. Each bit represents one function output. Nay output specified here will have the effects of CV55 and 56 applied. Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in set. Presents one function is activate with CV29 bit 4 is set. Default anduces: 9.18, 27, 36, 45, 54, 63, 72, 81,	80 40 0 50 50 32 60 0 168 84 1 100 212 126 42	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-
51 52 53 53 54 55 56 57 58 59 60 61 62 64 67-94 96 97 98 104	 Diverse State optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV53=66: programming and feedback off CV53=77: programmed CV value CV53=2: 200+ programmed CV value PWM for function output sipecifies the level of dimming applied to any function output with dimming selected via CV S7. Note that any function output with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Usful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output segned to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV55. Time is set in 0.1 second units. Dimming mask: turns dimming (level defined in CV54) on and off for each function output. Each bit represents one function output. Any output specified here will have the effects of CV55 and 56 applied. Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only available in ZIMO environment Signal controlled speed: "L" only availab	80 40 0 50 52 60 0 100 100 212 126 42 0	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-
51 52 53 53 54 55 56 57 58 59 60 61 62 64 67-94 96 97 98 104	 Privalue: optimises EMF characteristics. Modify this to adapt to specific motor requirements (proportional part). I-Value: optimises EMF characteristics. Modify this to adapt to specific motor requirements (integral part). For Roco Lokmaus users and any other systems which can only address CVs up to 99. Set bits 0 or 1 to address CVs over 99. Not necessary on most DCC systems. CV33=6: programming and feedback off CV33=1: 100+ programmed CV value CV33=1: 100+ programmed CV value CV33=2: 200+ programmed CV value PWM for function outputs with dimming switched on have the same dimming level applied – they are not individually dimmable by different amounts. Useful for reducing brightness of lights, or level of smoke generator for example. CV54=50 means 50% power output on function. PWM for decoupler: represents the 'holding' current for the decoupler i.e. the reduced power for holding after the uncoupling impulse. Any function output defined as a decoupler (CV58) will initially get a higher-current pulse sent to that output when the function is activated, designed to 'kick' the magnet of a decoupler into motion, but then after a period (defined in CV56) it will be reduced to the level specified by this CV55 to hold it. Specified as a percentage. Decoupler pulse time: how long is the impulse on the decoupler with full power until it is reduced to the value defined in CV53. Time is set in 0.1 second units. Dimming mask: for decoupler function: defined which outputs should have decoupler processing applied. Each bit represents one function output, up to 4 functions (bits 0, 1, 2 and 3). Dimming mask for decoupler function: defined which outputs should have decoupler processing applied. Each bit represents one function degreed: "U" only available in ZIMO environment Signal controlled speed: "U" only available in ZIMO environment Signal controlled speed: "U" only available in ZIM	80 40 0 50 52 60 0 168 84 1 100 212 126 42 0	0-255 0-255 0-255 0-255 0-100 0-100 0-100 0-100 0-255 0-

105	User CV: free for remembering purchase date or similar user information	0	0-255
106	User O/ free for remembering purchase date or similar user information	0	0-255
107	Brake therebald triggering of final brake sources counds (flats 27, 20 and 20, 22), CV(107–E0 triggers these brake	0	0 255
107	blake threshold, triggering of initial blake sequence sources (slots 27-29 and 50-52). CVL07=50 triggers these blake	0	0-255
	sounds when speed steps from 25 down to step 24. CV10/=0 triggers final brake sounds when speed steps from 1 to		
	step 0 i.e. actually stopped (recommended – for example, final braking sounds where loco comes to an actual		
	standstill).		
108	Bitmask for endless manual sound: ONLY operational when CV49 bit 5 is set. For use with LGB pulse chains.	0	0-255
	Bit 0 for sound 1; bit 1 for sound 2 etc.		
109	Selection of CV set: bit 0=0 gives CV set 1; bit 0=1 gives CV set 2. Can be used for various purposes – CV set for home	0	0-1
	layout + CV set for club layout for example. Hard reset will only affect the currently selected CV set. CV109 will be		
	unchanged by a hard reset.		
110	Load-dependent sound variation: set to 0 to give no load-dependent variation: then a range from 1 (high dependency)	4	1-15
	to 15 (low dependency on load). If configured carefully this feature can be used to detect a beaw train or unbill	•	1 10
	climbs and cause the sound (chiffs for steam) to use the 'acceleration' sounds under that load. However, heware		
	using a procession value have will example the train to produce unpersonally loud druffs at unpublic time or a translition		
	using an excessive value here will cause the train to produce unnecessarily roud churs at driwanted time e.g. travening		
111	around a curve.	255	0.200
111	acknowledgement pulse (ACK). Improves the programming Capability, 126 is approx 50% of max	233	0-233
110	acknowledgement puse (motor dependent) 200 – normal.	255	0.255
112	Random sounds at standstill, chooses which sounds may occur randomly while foling. Set to 0 for no random sounds	200	0-255
	at standstill or set bits 0-7 to control which sounds are included in random play (Effects 1-8). See also CV131. It is not		
	possible to specify sounds 9-16 for random play.		
113	Random sounds during motion: chooses which sounds may occur randomly while the loco is moving. Set to 0 for no	255	0-255
	random sounds while moving or set bits 0-7 to control which sounds are included in random play (Effects 1-8). See		
	also CV131. It is not possible to specify sounds 9-16 for random play.		
114	PWM for effects – some of the lighting effects pulse between a high point and a low point. This CV specifies the level	0	0-100
	of the low point in those cycles. See also CV154 to 161.		
115	Cycle time for flashing light effects, as specified by CV154-161	0	0-255
116	Shunting function (yard mode) configuration (shunting mode may be switched on/off via appropriate function	0	0-255
	mapping – see CT extended function mapping document for more information):		-
	Only active if bit0-bit2 set		
	Bit 0 (1) – effects of CV3 and CV4 are disabled when shunting mode activated		
	Bit 1 (2) - maximum spand is halved		
	Bit 2 (4) maximum specer is a few of maximum speed (regardless of chunting mode) applies from SW Varian 40 or later		
	Bit 2 (4) - reverse is 05% of maximum specu (regardless of shuthing mode) - applies from sw version 40 of later		
	Di 4 (10) brokes with clobe 4.15 active - see also CV 102		
	Bit 5 (20) active denote the 0		
	Bit 5 (32) - not used, must always be U		
	Bit 6 (64) - means that the "Rangierfunktion" acts as a command button that is, that the automatic train control system		
	(brake or diode and HLU) - (equivalent to the MAN key = manual)		
	Bit 7 (128) – short burst of idling, returning to normal speed		
117	Defines the Function key that causes the <i>Low-Beam</i> dimming effect to be applied.	0	1-12
	1=F1, 2=F2 12=F12. See also CV118, 119 and 120.		
118	Mask to specify which function outputs have Low-Beam dimming applied when activated by the function key specified	0	0-255
	in CV 117. Each bit represents 1 function output (0-7). 1 = white wire, 2 = yellow wire, 4 = green wire, 8 = purple wire,		
	$16 = 5^{\text{th}}$ output, $32 = 6^{\text{th}}$ output, $64 = 7^{\text{th}}$ output, $128 = 8^{\text{th}}$ output		
119	PWM dimming level for Low-Beam dimming as defined by CV117 and CV118. A value of 50 = approximately 50% of	0	0-100
	full brightness, 100 = 100% i.e. no dimming. 0 also means no dimming.		
120	Cycle duration of how long the <i>Low-Beam</i> dimming will last – see CVs 117, 118 and 119.	0	0-255
121	Volume for main sound on. Values depend upon software version:	63	0-63
	Old versions have range 0-3 only (0 gives no sound, 3 gives maximum volume).		
	Newer versions have range 0-63 (63 being maximum)		
	Expect that future versions may range from 0-255		
122	Volume: At Papartitions for sound effect 1 (Slott 37-41); bits 0-1 specify volume; bits 2-4 for number of repetitions of	3	0-255
122	widdle cound (Slot 20); bis 5.7 doing number of ropertinger of sound effect vorall. If the 'Alternate' counds are	5	0-233
	activated this applies to sound effect 9 instead (Clote 77-91)		
122	Volume R Denetitions for cound affect 2 (fors 2) 420 bits 0.1 consist values bits 2.4 for surplus of months of	2	0.255
123	volume & Repetitions for source effect 2 (solts 42-40), bits 0-1 specify volume; bits 2-4 for number of repetitions of middle equal ((14) and (24)	3	0-200
	initiality sound (sioi 44), bits 5-7 define number of repetitions of sound effect overall. If the 'Alternate' sounds are		
124	activated, this applies to sound effect to instead (Slots 62-66)	2	0.255
124	volume & Repetitions for sound effect 3 (Slots 4/-51): bits 0-1 specify volume; bits 2-4 for number of repetitions of	3	U-255
	middle sound (Slot 48); bits 5-7 define number of repetitions of sound effect overall. If the 'Alternate' sounds are		
L	activated, this applies to sound effect 11 instead (Slots 87-91)		
125	Volume & Repetitions for sound effect 4 (Slots 52-56): bits 0-1 specify volume; bits 2-4 for number of repetitions of	3	0-255
	middle sound (Slot 54); bits 5-7 define number of repetitions of sound effect overall. If the 'Alternate' sounds are		
	activated, this applies to sound effect 12 instead (Slots 92-96)		
126	Volume & Repetitions for sound effect 5 (Slots 57-61): bits 0-1 specify volume; bits 2-4 for number of repetitions of	3	0-255
	middle sound (Slot 59); bits 5-7 define number of repetitions of sound effect overall. If the 'Alternate' sounds are		
	activated, this applies to sound effect 13 instead (Slots 97-101)		
127	Volume & Repetitions for sound effect 6 (Slots 62-66): bits 0-1 specify volume; bits 2-4 for number of repetitions of	3	0-255
	middle sound (Slot 64); bits 5-7 define number of repetitions of sound effect overall. If the 'Alternate' sounds are		
	activated, this applies to sound effect 14 instead (Slots 102-106)		
128	Volume & Repetitions for sound effect 7 (Slots 67-71): bits 0-1 specify volume; bits 2-4 for number of repetitions of	3	0-255
-	middle sound (Slot 69); bits 5-7 define number of repetitions of sound effect overall. If the 'Alternate' sounds are		-
	activated, this applies to sound effect 15 instead (Slots 107-111)		
129	From SW version 40 onwards CV 129 has this meaning:	3	0-255
125	Volume & Renations for sound affect & (Slot 27-76); bits 0-1 specify volume; bits 2.4 for number of constitues of	, j	5 255
	middle sound (Sto Tab bits 27 define number of renations of sound affect outset.) If the "Alternative sound sto		
	initiale sound (stor //), bits 5-7 define number of repetitions of sound effect overall. If the Alternate sounds are activitied this applicate sound effect 16 instead (Stor 112, 110)		
	acuvateu, tins applies to sourid effect to instead (SIOIS 112-110)		
	Note that it is not possible to individually control the values of leaving of sound offs to 0.10 (0.00, 77, 110).		
	to be an the acting for the antiquary control the volume or looping of sound effects 9-16 (slots //-116) – they		
	take on the settings for the equivalent effect In sounds 1-8.		

	Drive to CM version 40 -CV 100 had the following meaning:		
	Strong time when the sound after acceleration is being strongly reduced (0.5 second units), valid for sounds in Slots 0-		
	3 (this has moved to CV 146 from SW Version 40 onwards)		
130	Weak time – how long the deceleration chuffs (Slots 8-11)) should continue for after reducing speed (0.5 second units).	4	0-255
131	Random time: minimum time between 2 random sounds (0.5 second units)	20	0-255
132	Stroke Base-H: Time between 2 speed strokes at full speed	100	0-255
133	Stroke speed at step 1 (LOW byte): time between two steam strokes at speed step 1 in seconds. This can be a large number, so is defined using 2 CVs (133 and 134 with the LOW byte in CV133 and HIGH byte in	153	0-255
	CV134).		
	Calculated via the formula: K = 1476 / time (1476 is a constant always used for this calculation by the decoder)		
	Example 1: K=153 gives approximately 9.6 sec between chuffs		
	Example 2: if 20 seconds wanted between chuffs, so $K = 14/6 / 20 = /3.8$ rounded to /4 gives CV133 = /4, CV134 = 0 Example 3: if 3 seconds wanted between chuffs, so $K = 1476 / 3 = 402$. Since $K > 256$ we need to use 2 bytes, so solit		
	low byte and high byte: $492 / 256 = 1.927875$ thus CV134 = 1 (rounded down), CV133 = remainder i.e. $492 - (256 * 1)$		
	= 236		
134	Stroke speed at Step 1 (HIGH byte): time between two steam strokes at speed step 1 in seconds – see also CV133.	0	0-255
135	Frequency min: reduces the pitch of chuffs or engine sounds at lower speed steps. 128 is default pitch (sounds played	128	0-255
	as originally recorded). Use this CV along with CV136 to define how engine nitch or chuff nitch increases with the speed of the loco		
136	Frequency max: increases the pitch of chuffs or engine sounds at higher speed steps. 128 is default pitch (sounds	128	0-255
	played as originally recorded).		
137	Special CV	0	0-255
	Bit 0 (1) - OFF = 8 functions, ON = 14 functions (MAN-bit) refers to F0-F12, btw CV33-CV46 free assignment.		
	Bit 2 (4) - strong / normal / weak switched with F1_effective only when CV110 is active and dimmable via CV54		
	Bit 3 (8) - strong / normal / weak switched with F2, effective only when CV110 is active, and dimmable via CV54CV137		
	Bit 4 (16) – ZIMO speed contrl - dependent train control $0 = off 1 = on$		
	Bit 5 (32) - Start sequence (Sound Slots 21-23) is played before motor starts to spin – useful for diesel engines in		
	particular as a rev-up sound before physically setting off Bit 6 (64) – Set ON if you want to control additional functions using E4 – press twice for E5. 3x for E6. 4x for E7 (useful if		
	your controller does not have access to many functions directly)		
	Bit 7 (128) - 32kHz frequency motor control from software version 41, factory Bit7 = 0 16kHz		
138	Break time (HLU): break delay for HLU section (for ZIMO systems only)	3	0-255
139	Short-circuit threshold 1: direct cut-off at overload of function outputs	15	0-255
140	Short-circuit threshold 2: fast cut-off at overload of function outputs	12	0-255
141	Short-circuit threshold 1: direct cut-off at overload of motor output	90	0-255
143	Short-circuit threshold 2: fast cut-off at overload of motor output	80	0-255
144	Short-circuit threshold 3: slow cut-off at overload of motor output	70	0-255
145	Activation of sound looping - if the corresponding sound function is activated, it will first play its 1 st and 2 nd Slots. After	0	0-255
	that, Slot 3 is repeated until the feature is turned off. After requesting off, it plays closing 4 th and 5 th Slots.		
	Bit 1 (2) - for looping of Sound 1 (Slots 37-41) Bit 1 (2) - for looping of Sound 2 (Slots 42-46)		
	Bit 2 (4) - for looping of Sound 3 (Slots 47-51)		
	Bit 3 (8) - for looping of Sound 4 (Slots 52-56)		
	Bit 4 (16) – for looping of Sound 5 (Slots 57-61) Bit 5 (22) – for looping of Sound 6 (Slots 52-66)		
	Bit 6 (64) - for looping of Sound 7 (Slots 67-71)		
	Looping for Sound effects 8-16 cannot be configured – they are not looping.		
146	From SW Version 40 onwards, CV146 has the following meaning (used to be in CV129):	12	0-255
	Strong time: time that the acceleration chuffs sounds (Slots 0-3) continue after strong acceleration (0.5 seconds units).		
	CV146 = 1 means: Z3 (switching function) is connected with F7.0 means inactive 73		
	CV146 = 2 means: Z4 (switching function) is switched with F8, 0 means inactive Z4		
	CV146 = 4 means: Sound3 is connected with F7, 0 means inactive Sound3		
	CV146 = 8 means: Sound4 is connected with F8, 0 means inactive Sound4		
	CV140 = 10 means: 25 (switching function) is switched with F9, 0 means inactive 25 $CV146 = 32$ means: Z6 (switching function) is switched with F10. 0 means inactive Z6		
	CV146 = 64 means: Sound5 is connected with F9, 0 means inactive Sound5		
	CV146 = 128 means: Sound6 is connected with F10, 0 means inactive Sound6		
147	Discharge of the coupling: a kickback effect causing the locomotive to run backwards slightly – a tiny jerk of the motor	20	0-126
148	to achieve uncoupling. Away from wagons: speed when driving away from wagons, locomotive runs in the current direction 126 – may Speed	50	0-126
1-10	under. Take into account the time set in CV3.	50	5 120
149	Discharge time: the time for the unit pushed back. 0.1 seconds, 10 = 1 seconds	10	0-255
150	Drive away: the time for driving away unit 0.1 seconds, 30 = 3 seconds	30	0-255
151	Selection of automatic disconnection: $0 = off$, $1 = F1 2 = F2 3 = F3$, $4 = F4$, etc.	0	1-12
152	Uncoupling mask forwards: Select the function to be used, $4 = F2$, $8 = F3$, $16 = F4$, $32 = F5$, $64 = F6$, $128 = F7$	8 8	U-255 0-255
153	Lighting effect for front light (output 0 white wire):	0	0-255
	0 - No effect	-	
	1 - Flashing		
	2 - Flash-pull		
	3 - Sirigie puise strobe 4 - Double Flashing strobe		
	5 - Headlight (brightness between maximum and PWM value in CV 114)		
	6 - Ditch light left (brightness between maximum and PWM value in CV 114)		
	7 - Ditch light right (brightness between maximum and PWM value in the CV 114)		

	8 - Rotary beacon (brightness between maximum and PWM value in the CV 114)		
	9 - Gyralite (brightness between maximum and PWM value in the CV 114) – can also be used for firebox glow		
	10 - Mars light		
	11 - Soft-start		
	12 - Brake sparks (short flash activated only when the loco comes to a stop)		
	For output when forward only, add 64 to the above value e.g. $1 + 64 = 65$ flashing on Forward only.		
	For output when in reverse only, add 128 to the above value e.g. $1 + 128 = 129$ flashing on Reverse only.		
	If neither 64 nor 128 is added, it is assumed that the effect should be active for both forwards and reverse.		
	CVs 155 -161 provide the same effects for each of the other function outputs.		
155	Lighting effect for function output 1 (yellow wire) - see CV154	0	0-255
156	Lighting effect for function output 2 (green wire) - see CV154	0	0-255
157	Lighting effect for function output 3 (purple wire) - see CV154	0	0-255
158	Lighting effect for function output 4 (solder pad) - see CV154 (only on SL51-4)	0	0-255
159	Lighting effect for function output 5 (solder pad) - see CV154 (only on SL51-4)	0	0-255
160	Lighting effect for function output 6 (solder pad) - see CV154 (only on SL51-4)	0	0-255
161	Lighting effect for function output 7 (solder pad) - see CV154 (only on SL51-4)	0	0-255
162	Sensitivity of the diode voltage: see also CV116. Value of 10-20 is generally well tolerated, the smaller the value the	10	0-255
	more sensitive.		
163-176	Extended function mapping: Please refer to CT extended function mapping document for more information.	0	0-255
177	Trigger for rapid acceleration: indicates the number of speed levels that must be attained within any 100 msec period	0	0-252
	in order to trigger the sound in Slots 123-125). If the sounds are in three parts, the middle part is played in a loop until		
	the requested speed is reached. See also CV 107 for trigger to rapid braking sound.		

Safety Disclaimer

Not suitable for children under three years of age because of the danger of their swallowing the small constituent pieces. Improper use can result in injury from sharp edges. For use only in dry areas. CT reserves the right to make changes in line with technical progress, product maintenance or changes in production methods. CT accepts no responsibility for error that may occur of use of transformers or other electrical equipment that is not authorised for use with model railways or transformers and other electrical equipment that has been altered, adapted or are faulty. Nor can we accept responsibility for damage that results from unsupervised adjustments to equipment or from acts of violence or from overheating or from effects of moisture etc. Furthermore in all such cases the guarantee becomes invalid.

The SL75 is NOT delivered mounted in protective tubing – this is to reduce overall size. Fit the decoder using double-sided adhesive tape. There should be no contact between metal parts such as locomotive chassis or housing and the decoder. Insulate all metal parts with insulation tape so that short-circuit is avoided. Never cover the decoder with insulation tape as this will reduce the air circulation around the decoder which could harm it. Never touch the decoder when it is under power as this may damage both the software or hardware of the decoder.